

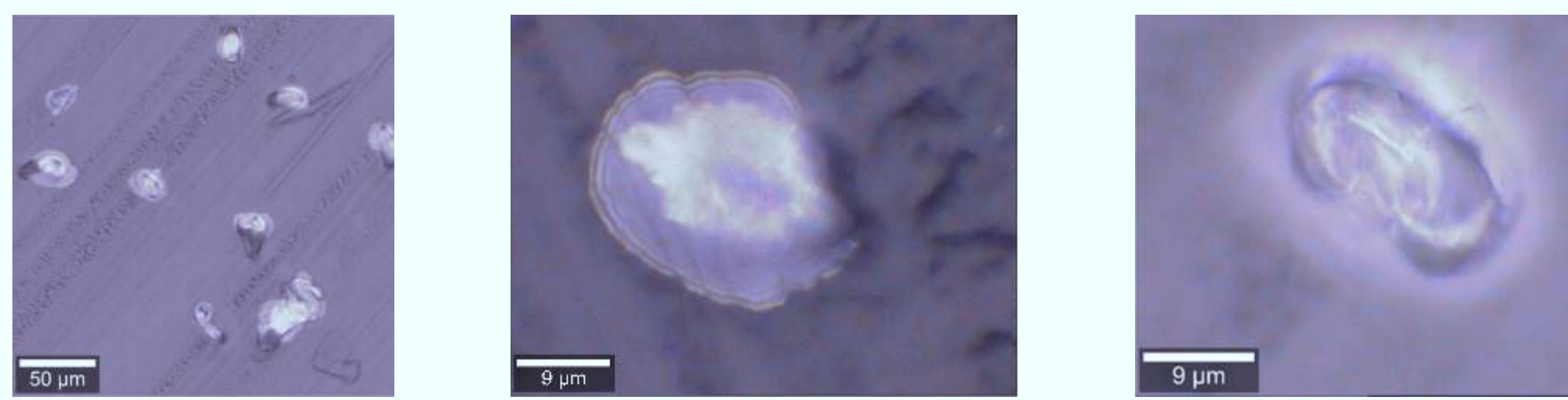
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INTRODUCTION

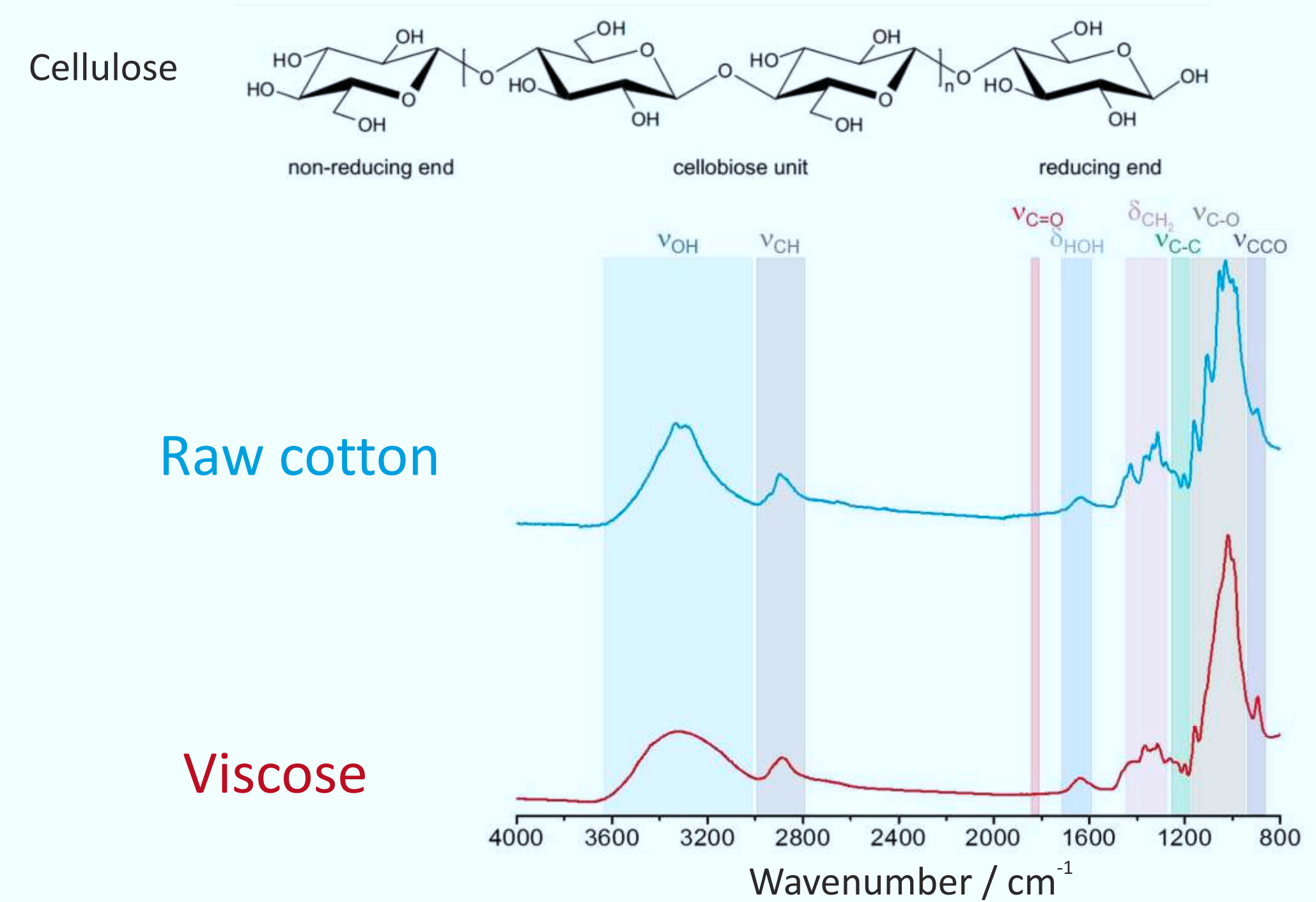
Man-made cellulosic fibers were identified as major fraction of plastic litter in the marine environment by means of FTIR transmission microscopy. [1] Here, three different techniques for collecting IR spectra (transmission microscopy, ATR microscopy and ATR spectroscopy) were compared to assess the plausibility of such findings which led to the conclusion that the choice of spectra acquisition method is essential for optimizing classification results. Also, ATR technique was found to be most suitable for spectra acquisition and classification of cellulose fibers. [2]

Furthermore, the cross-section of cellulose fibers was investigated by means of FTIR imaging, confocal Raman imaging and PTIR spectroscopy in order to assess parameters such as crystallinity. While FTIR and Raman imaging methods are diffraction limited, the lateral resolution can be significantly improved by PTIR spectroscopy.



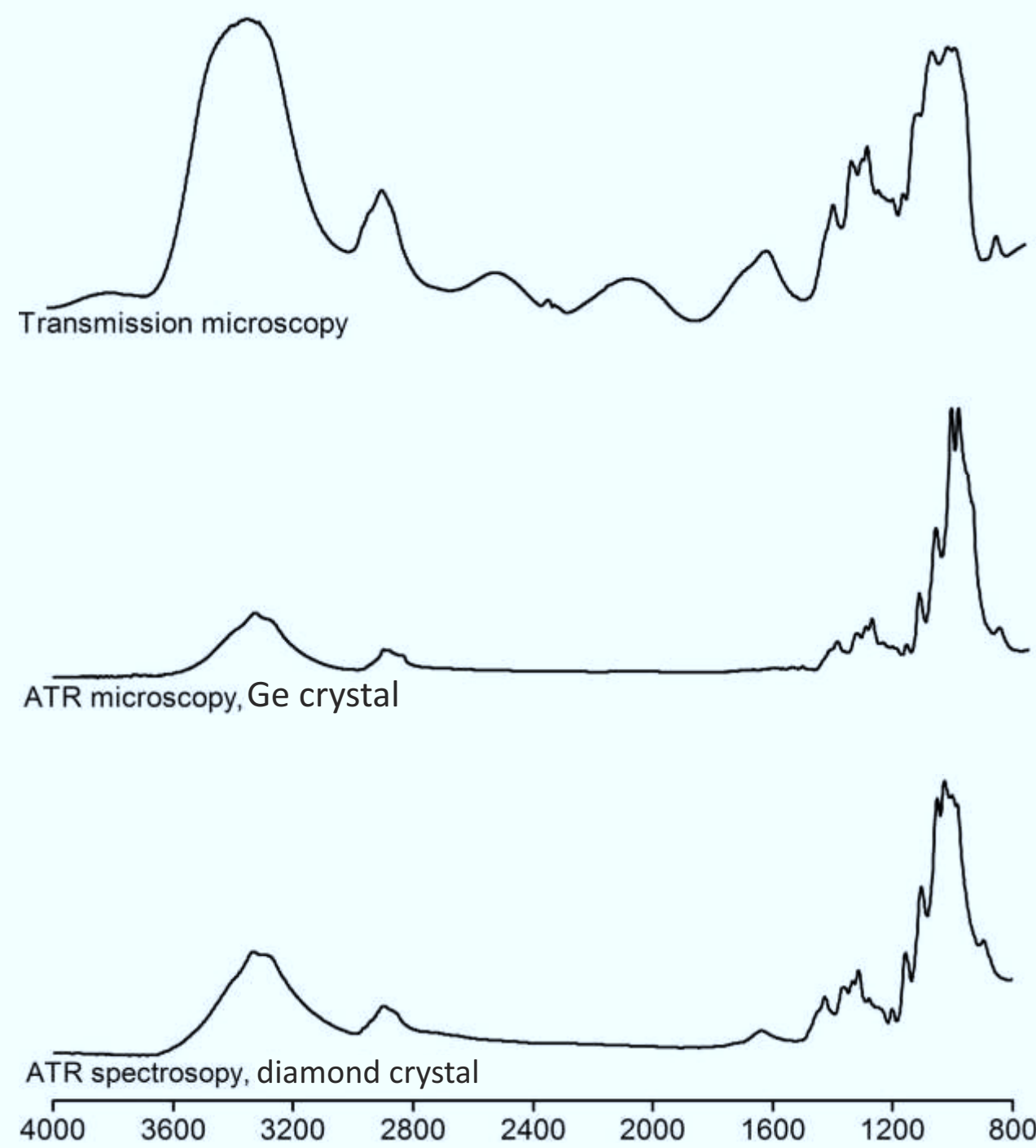
SAMPLE DETAILS

| | Natural fibers | Man-made fibers |
|--------------------------|------------------------|--------------------------------|
| Crystal structure | Cellulose I | Cellulose II |
| Degree of polymerisation | 3300 | 300-600 |
| Classification/types | Seed, Bast, Leaf, Wood | Viscose, Modal, Lyocell, Cupro |
| Diameter [μm] | 15-35 | 10-15 |
| Constituents [%] | | |
| Cellulose | 60-96 | >97 |
| Hemicellulose | 5-20 | - |
| Lignin | 0-11 | - |
| Pectin | 0-2 | - |

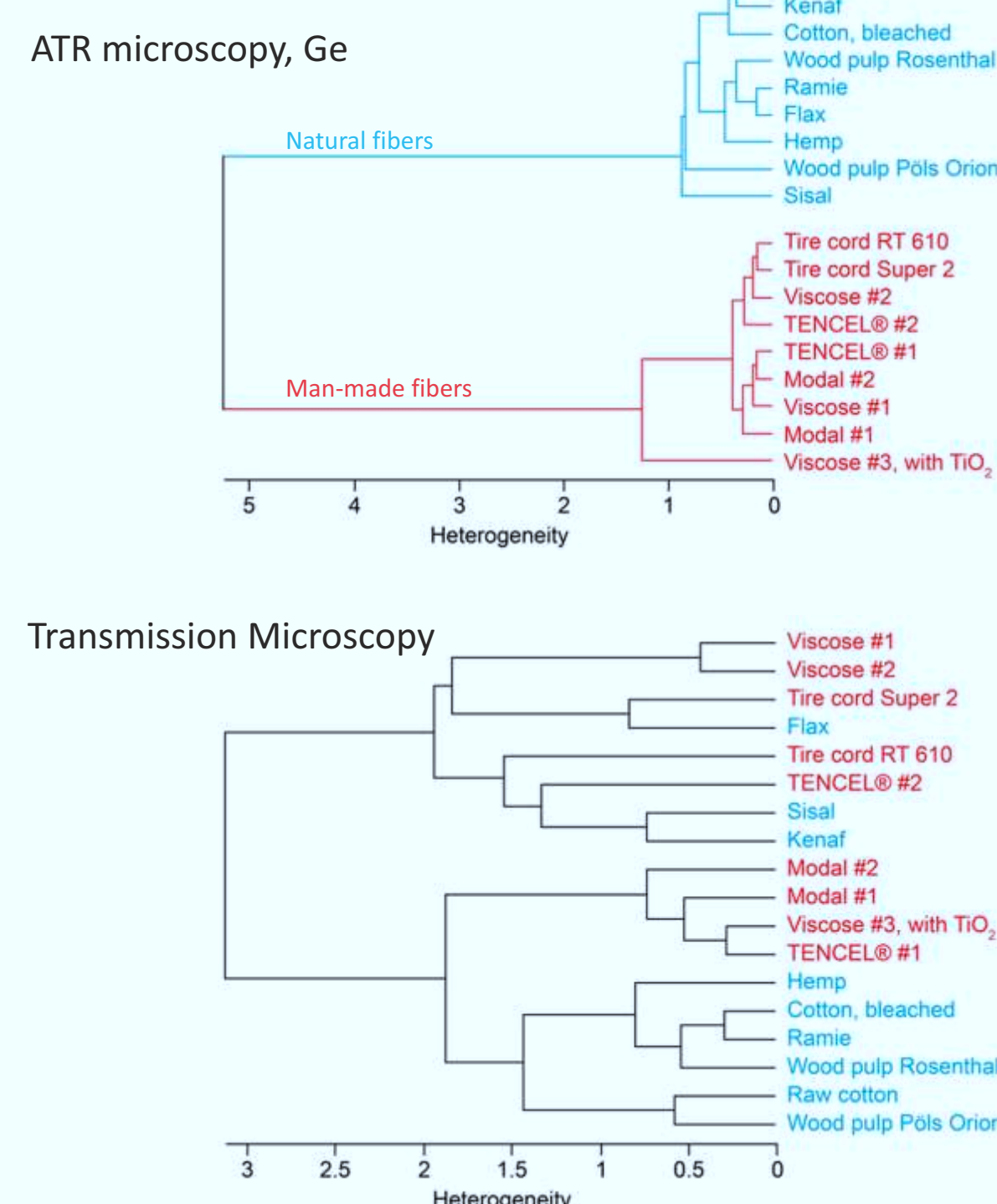


CLASSIFICATION OF CELLULOSIC FIBERS BY FTIR SPECTROSCOPY

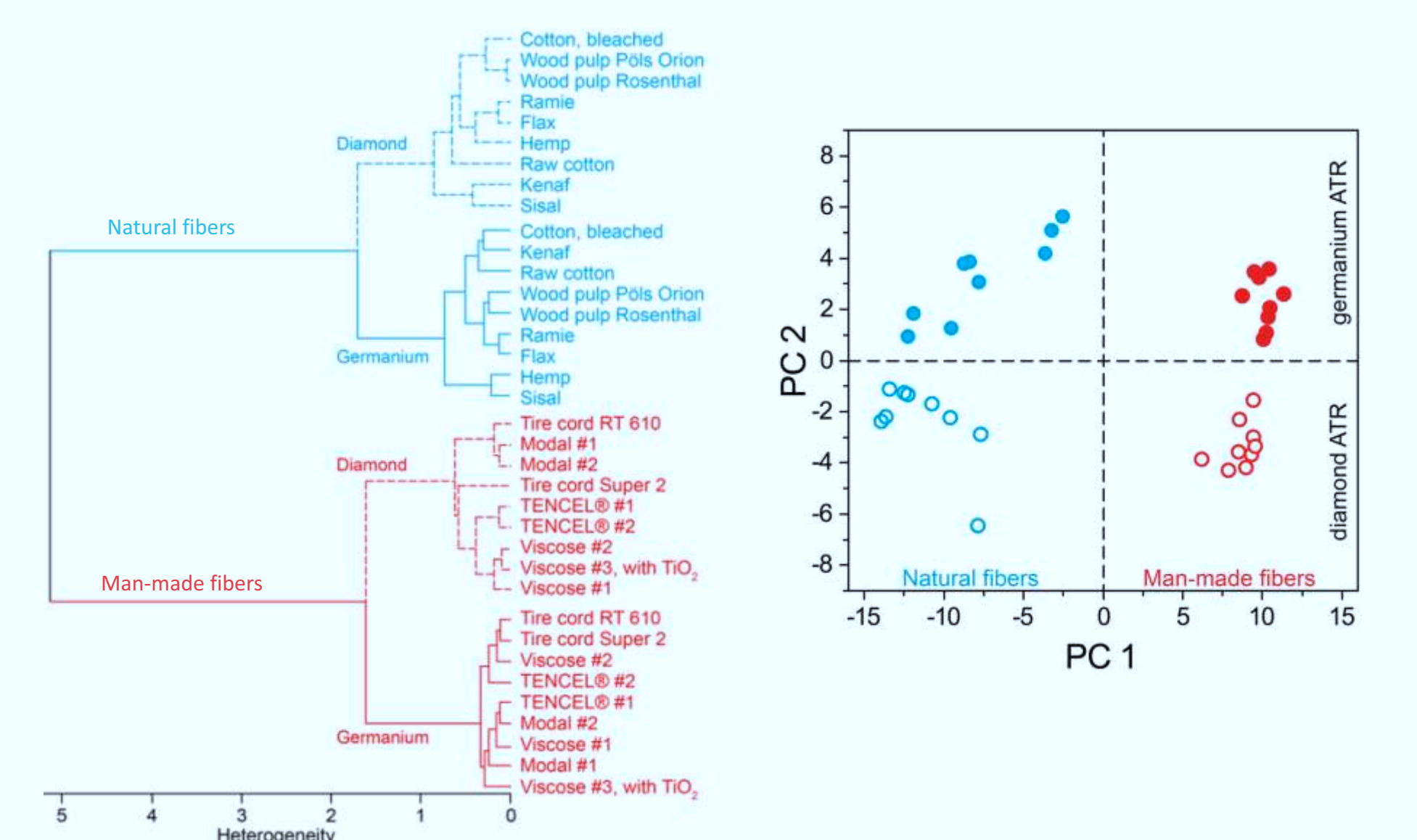
Example: Natural fiber (Ramie fiber)



HCA (Ward's algorithm, Euclidean distance measure)



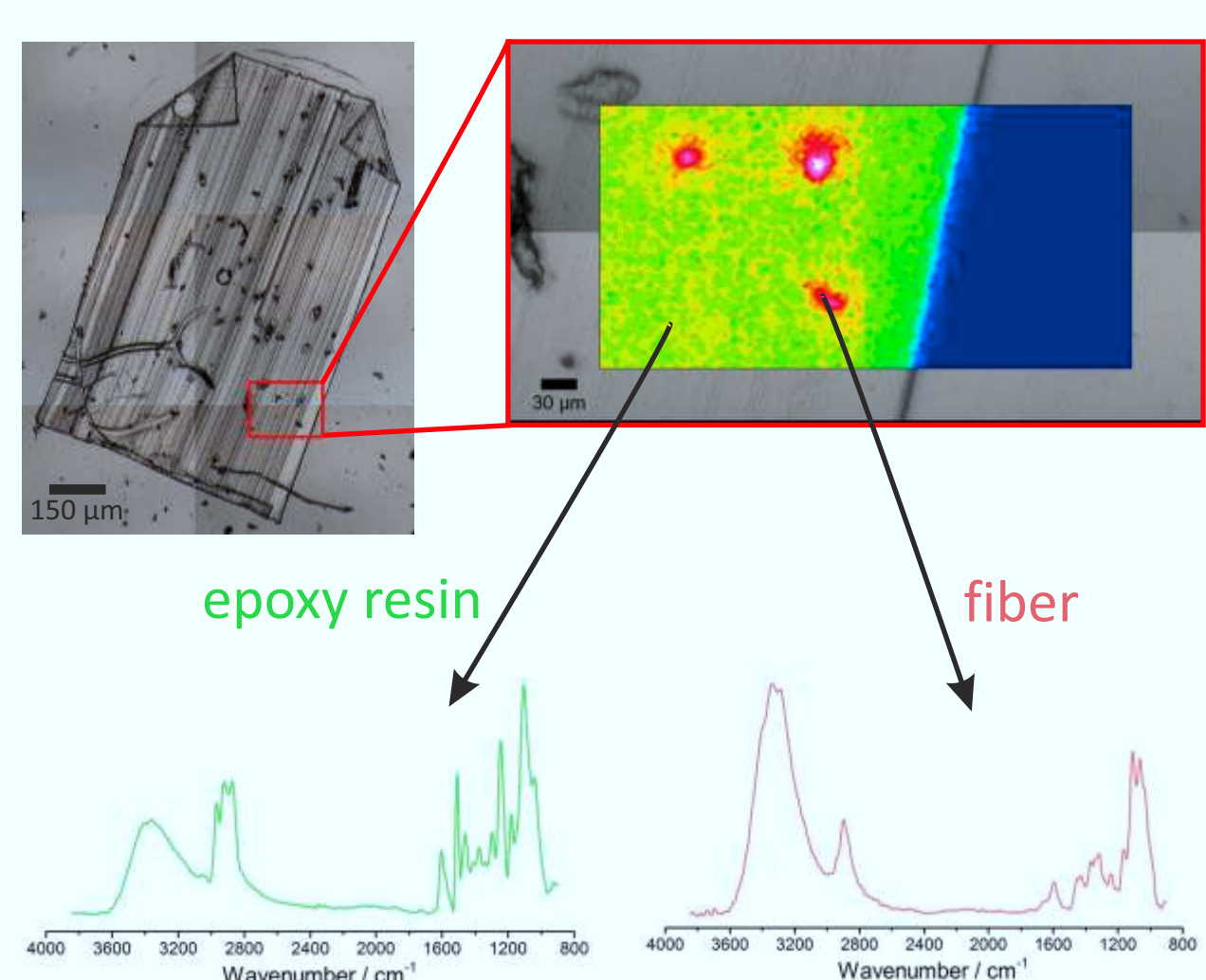
Unsupervised classification of ATR spectra (Ge & diamond)
HCA and PCA



FTIR & RAMAN IMAGING AND PTIR MEASUREMENTS OF SINGLE FIBER CROSS-SECTIONS

FTIR imaging

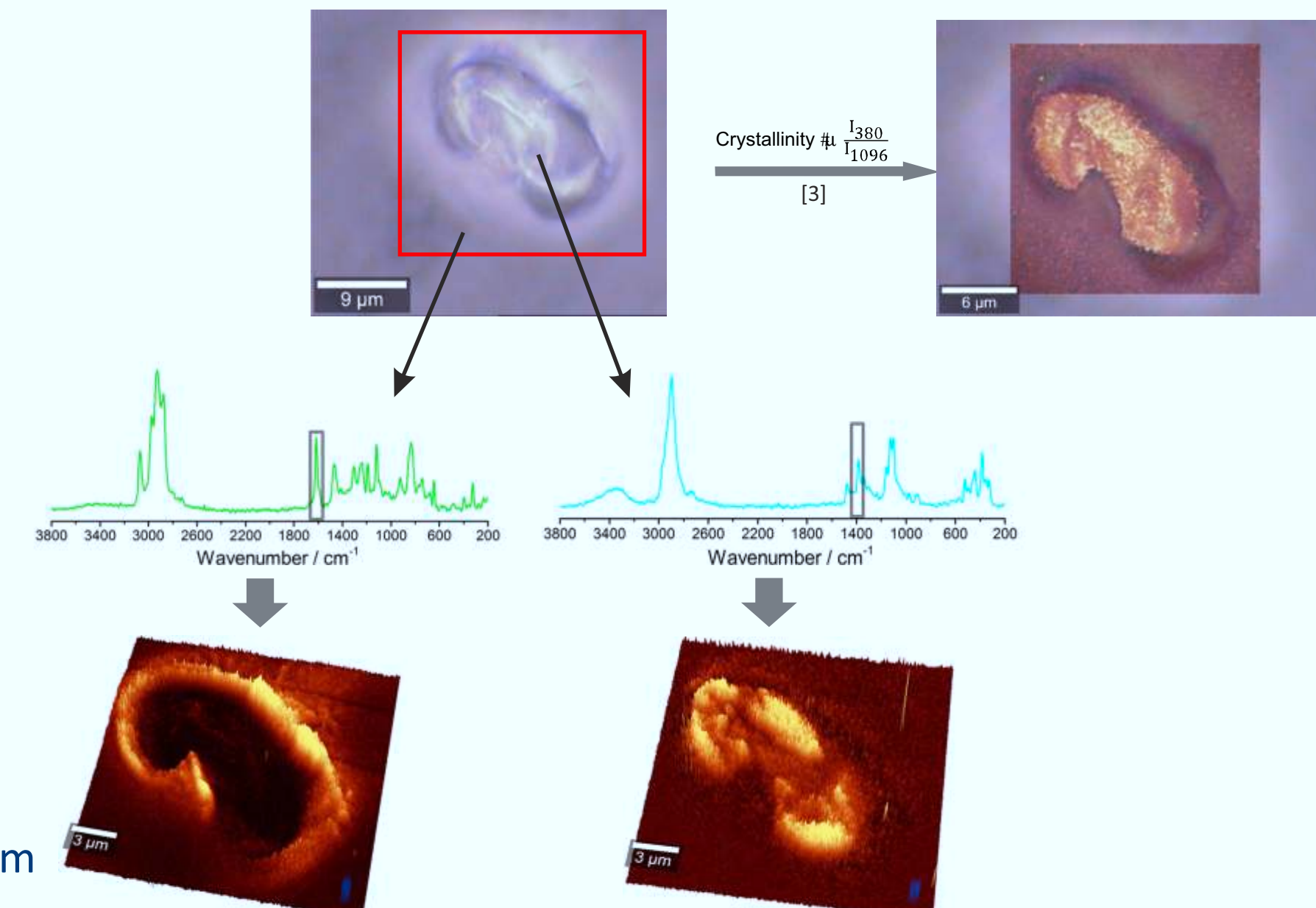
2 μm thick fiber cross section embedded in epoxy resin



approx. 5 μm lateral resolution

Confocal Raman imaging

2 μm thick fiber cross section embedded in epoxy resin



240 nm

< 50 nm

PTIR (Photo-Thermal Induced Resonance) spectroscopy

2 μm thick fiber cross section embedded in epoxy resin

